



RESEARCH NOTE LS-36

LAKE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

Heavy Crop of Red Pine Cones Yields Many Thousands of Good Seeds

Red pine (*Pinus resinosa*) usually produces good crops of cones at intervals of 3 to 7 years, with light crops occurring in most intervening years.¹ But, as in most tree species, little information is available as to what such crops mean in terms of actual seed production. In northern Minnesota medium-stocked stands of mature red pine were found to disperse from 75,000 to 110,000 seeds per acre in a moderately heavy year,² and a poorly stocked 40- to 50-year-old stand in Lower Michigan had an annual production (10-year period) ranging from 8,000 to 12,000 good seeds per acre.³

Little has also been recorded as to the time, rate, and quality of the seedfall. The Lower Michigan data indicate that, while dispersal began about mid-September and was 70-percent complete by mid-December, it continued at a low rate until the following August. Soundness during the period studied varied from 14 to 63-percent.³

To add to the knowledge of seed production, the Lake States Forest Experiment Station is conducting a comprehensive study in managed and natural stands and in two age classes, 50 and 90 years; a third age class, 120 to 140 years, has recently been added. Since the study has so far sampled only one good cone crop, no final conclusions can be made as to the seed production of these kinds and age classes of stands. However, because of the interest in the seeding and planting of this species, it would seem helpful to present the results obtained thus far.

METHODS

The data sampled the entire seed yield of the heavy 1957 cone crop on the Cutfoot Experimental Forest. It was collected from October 1, 1957, to

October 1, 1958, in three stand conditions in pure red pine: (1) 90-year managed, (2) 90-year natural or unmanaged, and (3) 50-year managed.

For the managed stands, seed production was sampled on the cutting units of two growing stock level studies, both of which had been cut to five different levels of basal area — 60, 80, 100, 120, and 140 square feet. In the 90-year timber, two blocks were involved — one of 5-acre compartments, the other of 21½-acre units. The 50-year stand had its compartments located in one block. Both age classes had been cut from above and below in 1949-50 and again 5 years later.

In the 90-year natural stand, a few jack pines had been salvaged during the thirties, but for all practical purposes it had never been cut. Basal area here averaged about 140 square feet of which 123 square feet were red pine and the balance mostly jack pine.

On each of these three stand conditions seed production was sampled by means of 1/4000-acre seed traps, which were emptied at 2- to 3-week intervals (sometimes 5 to 6 weeks) throughout the year. After counting, the seeds were pooled by growing stock levels within each stand class. The seed size and germination of the seed lots were then determined either for the whole lot or for a representative sample of it.

MANAGED STANDS PRODUCE MANY THOUSAND GOOD SEEDS

The yield of seed, both total and viable, for the year, October 1, 1957, to September 30, 1958, is given in table 1. Of the three stands, the 90-year managed timber was by far the best producer of seed, averaging over a million seeds per acre of which 916,000 were viable. On the other hand, production by the 90-year natural stand was less than half of that of the managed timber and that of the 50-year stand less than one-tenth as much.

Germination, considering that no attempt was made to eliminate the empty seeds, was quite high.

¹ U.S. Forest Service. 1948. *Woody-plant seed manual*. U.S. Dept. Agr. Misc. Publ. 654, 416 pp., illus.

² Shirley, Hardy L. 1933. *Improving seedbed conditions in a Norway pine forest*. Jour. Forestry 31: 322-328, illus.

³ Rudolf, Paul O. 1957. *Silvical characteristics of red pine (Pinus resinosa Ait.)*. U.S. Forest Serv., Lake States Forest Expt. Sta., Sta. Paper 44, 32 pp., illus.

TABLE 1 — *Total and viable seed production of managed and unmanaged red pine stands,¹ Cutfoot Experimental Forest, October 1, 1957, to September 30, 1958*

Basal area level (sq. ft.)	Seed production per acre		Average germina- tion	Average cleaned seeds per pound	Basis, seed traps
	Total seeds	Viable seeds			
	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Number</u>
90-YEAR MANAGED STAND					
60	919,400	794,400	83.9	66,800	6
80	981,300	817,200	81.3	67,600	6
100	1,004,000	867,400	84.3	65,000	6
120	1,300,300	1,120,600	85.4	67,300	6
140	1,148,000	980,300	83.4	66,200	6
All levels	1,070,600	916,000	83.7	66,600	30
90-YEAR NATURAL STAND					
140 ^{2/}	453,500	369,800	81.6	63,800	6
50-YEAR MANAGED STAND ^{3/}					
80	142,000	127,700	89.6	58,400	2
100	100,000	84,000	84.0	60,300	2
120	76,000	66,000	86.8	63,200	2
140	82,000	77,500	95.0	65,900	2
All levels	100,000	88,800	88.7	61,200	8

^{1/} Trapped seeds only; does not include losses from rodents and possible collection by cone pickers.

^{2/} Includes about 17 square feet of jack pine.

^{3/} No samples taken of the 60-square-foot level in 1957-58.

It varied from 82 percent for the natural stand to 89 percent for the 50-year managed stand; most of the seeds failing to germinate were empty. Good-quality commercially cleaned seed runs only a little higher, 95 percent or more. Because of its higher soundness, such seed is, of course, somewhat heavier (averaging 52,000 clean seeds per pound)⁴ than the seed in this study (58,400 to 67,600 per pound).

YIELD NOT RELATABLE TO STAND DENSITY

The data from the 90-year managed stand was subjected to an analysis which assumed seed production to be a linear function of density. However, the linear model did not adequately explain the seed yields at different densities; individual plot yields were widely dispersed about the regression line. Two items worth noting may have weakened this test: the small

numbers of seed traps (2 to 4 in each of 5 compartments), and the erratic yield pattern in the block having the poorer yields.

Some of the difference may have been due to the location of the compartments in the poorer-yielding block. These were either in small isolated stands of red pine (3 to 4 acres in size) surrounded by much younger stands or were on one edge of the main body of 90-year timber, within which, at some distance from its margins, the compartments of the better-yielding block were located. It may, therefore, be that some factors related to the location and size of these particular compartments had a negative effect on yield. If this is the explanation, the reduced yield in this block should also be evident in future seed crops. In general, seed production of this sample increased with density up to 120 square feet and then dropped off slightly (table 1).

Seed production by the 50-year managed stand tended to decrease as density increased, but the sample

⁴ See footnote 1, p. 1.

was hardly large enough to provide a reliable basis for judgment. This trend, however, unlike that shown by the treatments in the 90-year-old managed stand, agrees with recent findings in Lower Michigan. In a twice-thinned stand in that area, the number of cones produced in 1961, and presumably the amount of seed, decreased sharply as the residual basal area increased, the lightest thinning (174 square feet) bearing practically no cones. However, 1961 was a poor seed year for red pine.⁵

DISPERSAL OCCURS THROUGHOUT YEAR

Seedfall occurred throughout the year. It began in early October, continued at a high level during that month and November (54 percent of the total fall), gradually dropped to a low point in February, and reached a second peak in June. This is shown best by the 90-year managed stand (fig. 1).

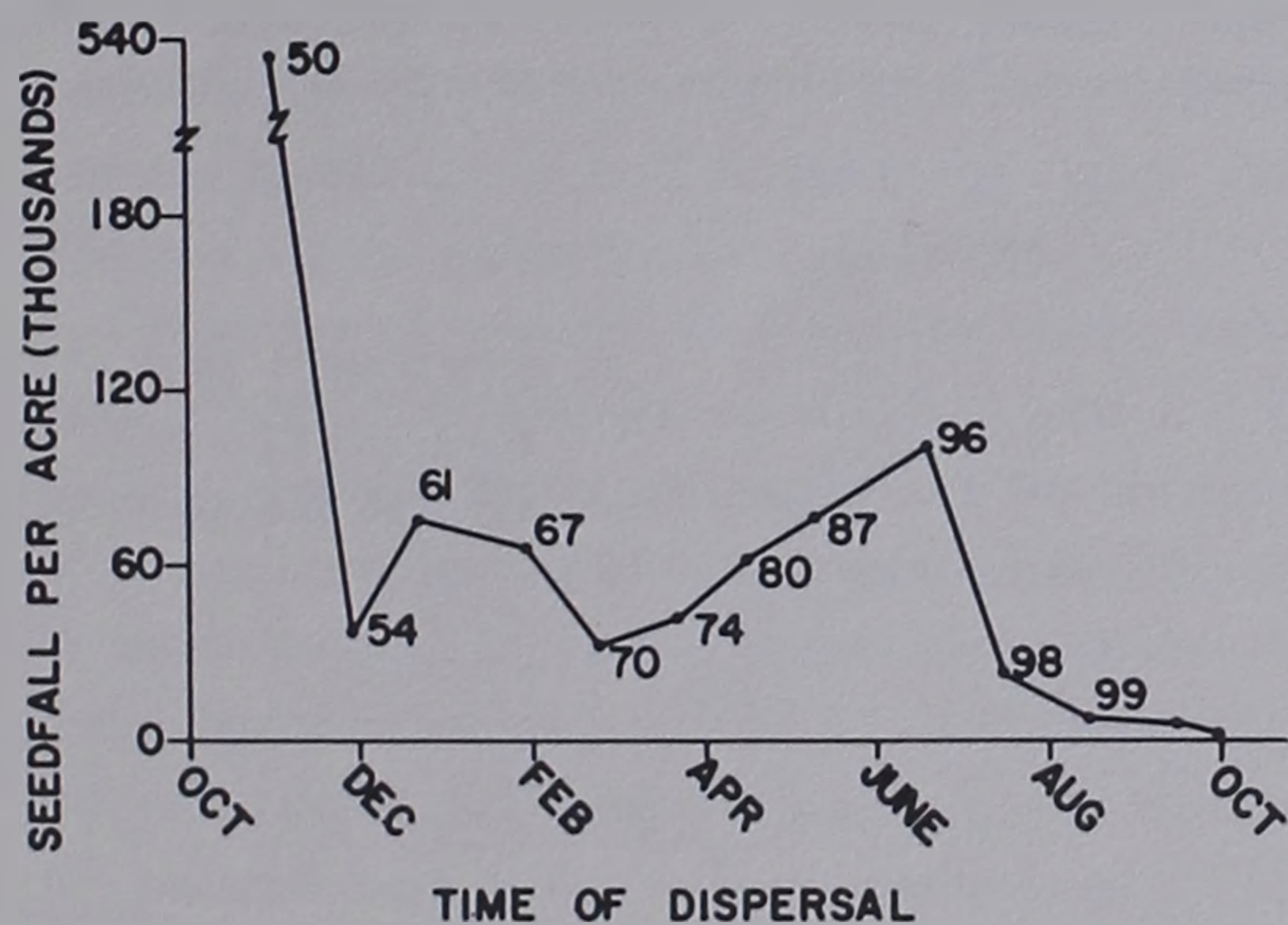


Figure 1. — Amount of seedfall as affected by time of year; 90-year managed red pine, all density levels. Values along trend line represent the proportion of the total seedfall collected up to the date shown.

Here, the daily fall averaged 16,200 seeds per acre during October, 1,300 in February, and 2,600 to 3,200 from April to mid-June. This pattern, in general, agrees with that found by Rudolf in Lower Michigan except that dispersal there began about 2 weeks earlier and was somewhat more rapid.⁶

An appreciable amount of seed was still being shed at Cutfoot at the end of the first year; in fact, 30 to 90 seeds per acre per day were trapped during the second season (1958-59) even though no new cones were observed to have been produced in the fall of 1958.

⁵ Godman, R. M. 1962. Red pine cone production stimulated by heavy thinning. U.S. Forest Serv., Lake States Forest Expt. Sta. Tech. Note 628, 2 pp., illus.

⁶ See footnote 3, p. 1.

QUALITY DECREASES WITH TIME OF DISPERSAL

Germination of the seed produced by the 90-year managed stand showed a general decline from the first collection to that of late February. It then increased with the rising seedfall, reaching a second peak in June and declining rapidly thereafter (fig. 2). Some of the seed trapped the second season was still good, however.

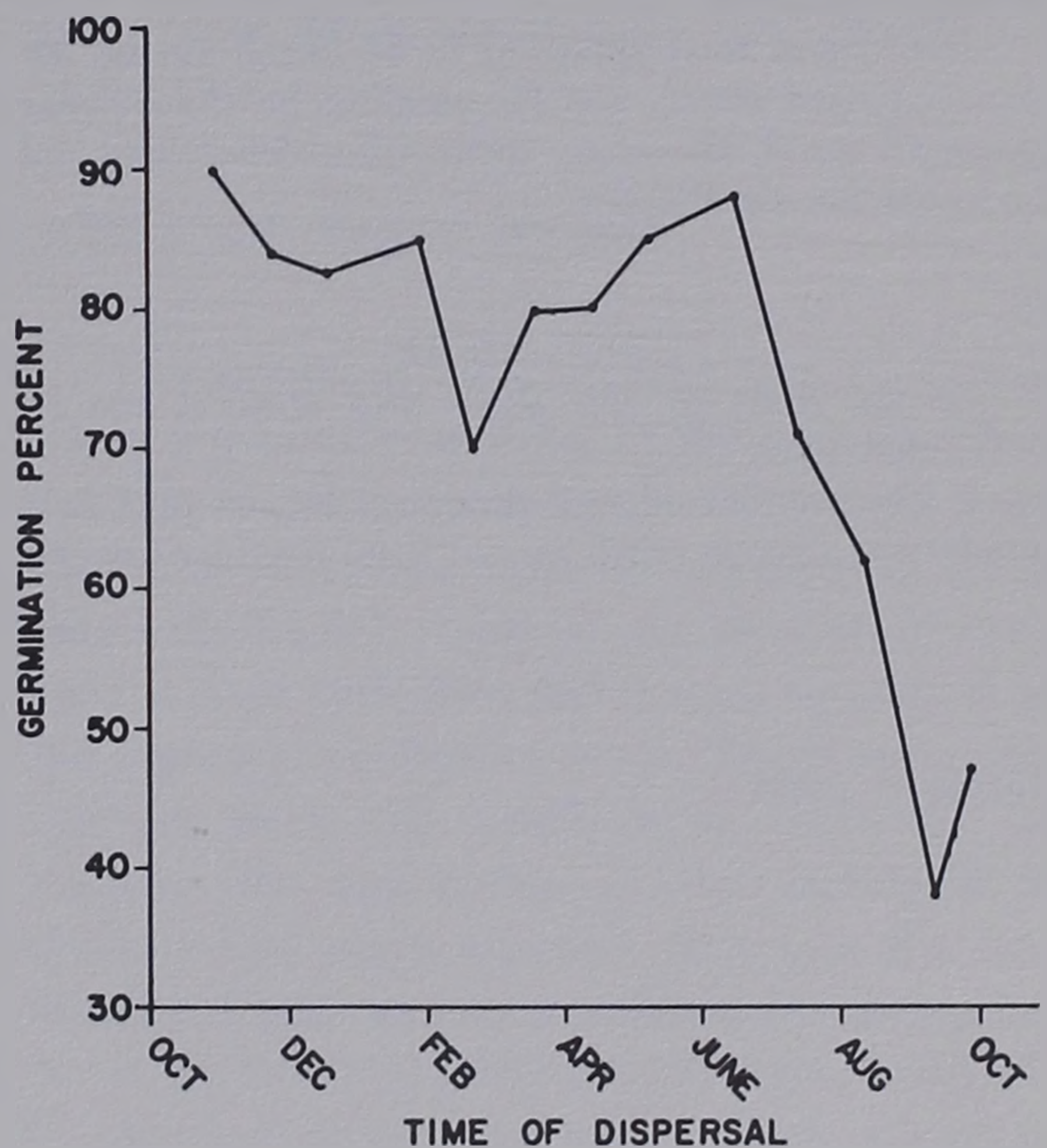


Figure 2. — Relation of germination to time of seedfall; 90-year managed red pine, all density levels.

Part of the reduction in germination was due to the greater proportion of empty seed and part to an increase in the number of filled seeds which apparently were dead at the beginning of the tests and did not germinate. Such dead seeds formed a significant portion of the yield only in the January 30 collection in the 90-year stands (7 percent of the yield)⁷ and in the July-September collections there (7 to 16 percent). At all other times dead seed did not comprise more than 2 percent of the yield; it usually was less than one percent.

HEAVIEST SEED FALLS FIRST

The number of clean seeds per pound increased markedly during the dispersal period. For the 90-

⁷ This seed was embedded in snow and could be retrieved only by collecting and melting the latter. Some may, therefore, have been injured during collection and subsequent treatment.

year managed stand, this value ranged from an average of 63,200 seeds per pound in October 1957 to 85,000 in mid-August 1958. Statistical analysis (regression method) showed that the relationship of number per pound to time was highly significant.

Some of the increase was due to the increasing proportion of empty seeds falling as dispersal ran its course (these were found to have a decided influence on the number per pound), and some may also have been the result of a decrease in the size and weight of the filled seeds.

The largest seed appeared to be borne by the 50-year managed stand, and the smallest by the 90-year managed stand. However, these differences could not be tested for significance.

CONCLUSION

On the basis of one heavy seed crop, it can be concluded that:

1. The amount of seed produced by red pine in a good crop year is much larger than previous reports

indicate. In this study it varied from about 16.1 pounds per acre for a 90-year managed stand to 7.1 pounds per acre for a 90-year natural stand. That from a 50-year managed stand, on the other hand, was only 1.6 pounds. Although total seed production appeared to be affected by stocking, this proved to be not significant.

2. The seed produced was of good quality in all stands, germination of the unfanned collections ranging from 82 to 89 percent. As a consequence, the 90-year managed stand bore 916,000 viable seeds per acre, the 90-year natural stand 370,000 seeds, and the 50-year managed timber 89,000 seeds.

3. Although half of the total amount of seed fell during the first month (October), some fell during the winter, and a significant amount also was shed during the spring and early summer months.

4. Seed soundness also decreased as time elapsed, indicating that seed of the best quality falls first. However, enough viable seed fell during the spring and early summer months to be of considerable significance from the standpoint of regeneration cuttings.

January 1964

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